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1997 CEWES MSRC PET Training Activities

by

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DoD HPC Modernization Program

Programming Environment and Training

CEWES MSRC



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Wayne Mastin*

January 9, 1998

1 Introduction

Training is the most visible part of the PET program for many of the CEWES MSRC users. During 1997, the PET training program passed several milestones. The first large conference, the **Colloquium on HPC Collaborative Methods and Tools**, was held at CEWES in February before an audience of approximately 100 DoD users from across the country. The first remote training class was also held in February, and now remote classes have become a routine part of our training schedule. Service to remote users was also improved when classes moved to the the Training and Education Facility (TEF). The TEF is furnished with professional quality video production and recording equipment. This has enhanced the Mbone broadcasts and improved the quality of recorded classes in the tape library.

The PET training team has worked closely with Jackson State University, the lead HBCU/MI institution. JSU has served as a testbed and consulted on the development of the TANGO collaborative environment system implemented by Syracuse University for offering remote training to off-site CEWES MSRC users. PET also conducted the **Introductory Summer Institute on High Performance Computing** at JSU which brought together 16 students from four HBCU/MI institutions for an intensive two-week training course on high performance computing.

2 Training Classes

PET training is designed to assist the CEWES MSRC user in transitioning to new programming environments and efficiently using the present and future SPP (Scalable Parallel Processing) hardware acquired under the HPCM program. The training curriculum is a living document with new topics being added continually to keep up with the fast pace of research and development in the field of HPC. The curriculum contains courses in the following general categories.

- Parallel programming
- Architecture and software specific topics
- Visualization and performance
- CTA targeted classes, workshops, and forums

Table 1 gives a list of all classes taught during 1997 with the organization offering the class, the number of students attending the class and the overall evaluation score of the class on a scale of 1 (poor) to 5 (excellent). From this table, we have the following totals.

*PET On-Site Team Lead, Nichols Research and Professor Emeritus, Mississippi State University

- Number of classes: 23
- Number of remote classes: 6
- Number of students: 254

Date	Class	Organization	Students	Evaluation
Jan. 7-9	MPI	MSU	15	3.6
Feb. 3-4	Domain Decomposition	Texas	17	3.9
Feb. 11	Fortran 90	OSC	11	4.7
Feb. 12-13	Advanced UNIX	OSC	11	4.4
Feb. 18	Parallel Programming Techniques	Rice	7	3.7
Feb. 24-26	Grid Algorithms and Tools ¹	MSU	9	4.3
Mar. 10-11	Origin 2000	SGI/Cray	4	5.0
Mar. 12-14	T3E Applications Programming	SGI/Cray	12	4.4
Apr. 10-11	Parallel Tools and Libraries ²	Tennessee	18	3.7
May 28-30	MPI ¹	MSU	16	4.4
Jul. 8-9	Parallel Tools and Libraries	Tennessee	10	4.2
Jul. 10-11	Performance Eval. of Parallel Systems	Tennessee	7	4.0
Jul. 15-18	T3E Applications Programming	SGI/Cray	7	4.0
Jul. 23-25	Java and WWW	Syracuse	10	4.5
Jul. 28-30	MPI ¹	MSU	17	4.3
Jul. 30-31	IBM SP Programming	OSC	8	4.6
Aug. 26-27	Visualization Systems and Toolkits	NCSA	6	3.7
Sep. 23-25	Introduction to C++ Programming	OSC	20	4.3
Oct. 6-10	SGI ProDev Workshop	SGI/Cray	5	4.3
Oct. 22-24	MPI ¹	MSU	16	4.0
Oct. 29-31	MPI	MSU	10	4.4
Nov. 4-6	Parallel Programming Workshop ¹	PET	6	4.8
Dec. 17-19	CTH	Sandia	12	4.5

¹Taught at NRL, Washington, DC

²Taught at AEDC, Arnold AFB, TN

Table 1: Classes taught from January through December 1997

All classes since July were held in the upgraded TEF. Except for the vendor offered classes, most of these were recorded on VHS tapes and broadcast over Mbone. Information on availability of tapes may be obtained from CEWES MSRC HPC User Support by email at info-hpc@wes.army.mil or phone at 601-634-4400 (option 1) or 1-800-500-HPCC.

3 Collaboration Colloquium

The CEWES MSRC **Colloquium on HPC Collaborative Methods and Tools** was held in the CEWES Auditorium on February 27-28, 1997. The purpose of the colloquium was to showcase methods of synchronous and asynchronous collaboration and to solicit discussion concerning their relation to DoD laboratory research and project management. Demonstrations of new, experimental tools to enhance collaboration were given in the Information Technology Laboratory. There were ninety-five attendees. The following is a list of presentations given during the colloquium.

3.1 List of Presentations

Asynchronous Tools Overview/NetWorkPlace Collaboration Environment, Mr. Alan Craig, NCSA, University of Illinois

Virtual Workshops, Ms. Kathy Barbieri, Cornell Theory Center, Cornell University

TANGO collaboration environment, Dr. Marek Podgorny, NPAC, Syracuse University

The Web May be Great - But Can We Make It Usable?, Prof. Cherri Pancake, NACSE, Oregon State University

TANGO Applications for Collaborative Systems, Prof. Geoffrey Fox, NPAC, Syracuse University

Ongoing Research at Arizona: Group Support Systems Application and the Development of Web Tools to Structure Collaboration, Dr. Daniel Mittleman, Center for Management Information, University of Arizona

VIMS - Virtual Institute Management System, Dr. Noshir Contractor, University of Illinois

Molecular Interactive Collaborative Environments (MICE), Dr. Philip E. Bourne, San Diego Supercomputer Center

Actual Collaboration Experiences using Java/Habanero, Dr. Donald Denbo, NOAA/PMEL, Seattle, Washington

Roundtable / Panel Discussion: How can HPCMP Enhance Collaborative Computing Among DoD Laboratory Researchers? Dr. N. Radhakrishnan (Chair), Prof. Cherri Pancake, Prof. Geoffrey Fox, Prof. Joe Thompson, Mr. Alan Craig and Dr. Robert Wasilausky.

4 Internet-Based Training Workshop

The PET training team was actively involved in the DoD User Group Meeting in San Diego. CEWES MSRC PET organized and sponsored a **Real-Time Distance Training Session** for the **Internet-Based Training Workshop** held on June 24, 1997. The purpose of the workshop was to investigate cost-effective means for providing education and training to remote users. The following presentations were given during the CEWES MSRC PET session.

4.1 Real-Time Distance Training Session Presentations

Paradigms for Distance Education, Mr. Alan Craig, NCSA, University of Illinois

Teaching over the Internet: A Low-Tech Approach with High-Impact Results, Ms. Nancy Davis, Georgia Tech

CEWES MSRC Training and Education Facilities Upgrade, Mr. John Eberle, Nichols Research

5 WES Graduate Institute

The WES Graduate Institute is an association of universities and CEWES through which academic credit and graduate degrees can be earned. The PET on-site staff supports the Graduate Institute by teaching graduate courses in high performance computing. During the spring semester of 1997 Dr. Wayne Mastin, PET On-site Team Lead, taught the MSU graduate course **MA 8463, Numerical Linear Algebra**. Nine students from CEWES completed the course and earned three semester hours of graduate credit from MSU.

6 Seminars

The PET program offers seminars on an irregular basis. These are presentations by experts in their field and are designed to introduce the CEWES MSRC users to current research topics in HPC. A list of seminar presentations for 1997 appears in Appendix B.

7 BYOC Workshops

The PET program has begun offering personalized workshops lead by the on-site staff. These are being referred to as Bring Your Own Code (BYOC) workshops. The student must be a DoD user who has a code in his/her research area that he/she is familiar with and may wish to use in his/her own work. After a brief introductory lecture, the instructor works with the student in getting his/her code running on one of the HPC computers. Future workshops will be designed to assist users in debugging codes and improving performance. Due to the need for considerable one-on-one contact for this type of workshop to succeed, a team teaching approach is used with a small number of students.

The first workshop was **Parallel Programming for Fortran Programmers**. After a prototype session at the CEWES MSRC, the workshop was offered at NRL on November 4-6, 1997.

8 HBCU/MI Efforts

PET academic partners Jackson State University and Syracuse University have worked together to refine distance education technology. The training class **Java and the WWW** was a Web-based training class used to test the TANGO collaboration system as a tool for distance education. That effort proved to be a success and TANGO was used to offer the class **Programming on the Web** to students in the Computer Science Department at JSU during the fall semester of 1997. The class was taught by Dr. Nancy McCracken at Syracuse University and received in a classroom at JSU. The class was broadcast over the internet using the DREN and the T1 line between CEWES and JSU. Further details on the class are found in the press release in Appendix C.

9 Conclusions

The CEWES MSRC PET training program has made considerable progress since the first training class was offered in August 1996. There is still work to be done, especially in delivering education and training to off-site users. Remote classes will continue to be scheduled where there are a sufficient number of users and available training facilities. At the same time, new developments in distance learning are being investigated with a goal to offer anytime, anypace, anyplace environments.

The scheduling of training classes and other events is coordinated with the MSRCs at ARL, ASC, and NAVO. Jointly sponsored activities, such as the **Grid Algorithms and Tools** class at NRL and the **Internet-Based Training Workshop** at the DoD User Group Meeting, will continue.

The training curriculum is driven by user needs and continues to evolve. The current schedule of training classes is on the Web at <http://apollo.wes.hpc.mil/msrc/training/f.cewes.html>. Suggestions for future training are always welcome and can be made by contacting Dr. Wayne Mastin by email at mastin@nrcpet1.wes.hpc.mil or by phone at 601-634-3063.

A Training Course Descriptions

MPI in Practice

Description

The important features of MPI will be covered with examples and illustrations. These features include point-to-point and collective communication, support for data types, virtual topologies, process-group and communication context management, and language bindings for the Fortran and C languages.

Method of Delivery

Lecture and demonstration

Prerequisites

Basic knowledge of parallel processing and familiarity with C or Fortran programming language.

Organization Providing the Training

ERC, Mississippi State University

Target Audience

Developers of parallel libraries and parallel applications, whose aim is to develop programs/applications that provide portability and performance over a wide range of high performance computing systems.

Class Duration

3 days

Students per Class

12

Domain Decomposition Methods for the Numerical Solution of Partial Differential Equations

Description

Course participants will learn the basic ideas of domain decomposition and how these ideas can be of use in developing efficient parallel algorithms.

Method of Delivery

Lecture

Prerequisites

Knowledge of finite element and finite difference methods for solving partial differential equations, and linear algebra.

Organization Providing the Training

University of Texas at Austin

Target Audience

Code developers interested in distributed parallel computation.

Class Duration

2 days

Students per Class

18

Introduction to the Fortran 90 Language

Description

This course will describe the new features found in Fortran 90 which are aimed at extending the usefulness of the language. These improved Fortran capabilities include free-form source code, pointers, dynamic memory management, array syntax expressions, a CASE construct, and derived data types capable of grouping together heterogeneous data.

Method of Delivery

Lecture

Prerequisites

Programming experience in Fortran 77

Organization Providing the Training

Ohio Supercomputer Center

Target Audience

High-level language programmers

Class Duration

3 days

Students per Class

18

Advanced Topics in UNIX

Description

The course will provide information needed to write and execute UNIX shell scripts used for the controlled execution of a series of basic UNIX commands. The course will also cover UNIX utilities available for the transfer and storage of large amounts of data.

Method of Delivery

Lecture

Prerequisites

Knowledge of basic UNIX commands and how to manipulate and list files and directories.
Users should be able to create and edit files using a text editor.

Organization Providing the Training

Ohio Supercomputer Center

Target Audience

Intermediate UNIX users

Class Duration

3 days

Students per Class

18

Survey of Parallel Programming Technologies

Description

This course surveys some of the software technologies used for writing parallel programs. It places emphasis on emerging standards in the field, such as HPF and MPI. Hints for using the various technologies are also given, particularly in terms of choosing the right tool for the right job.

Method of Delivery

Lecture

Prerequisites

Some knowledge of Fortran or other high-level language.

Organization Providing the Training

CRPC, Rice University

Target Audience

Programmers (and their managers) considering parallelizing applications.

Class Duration

1 day

Students per Class

18

Grid Generation Algorithms and Tools

Description

The course is designed for practitioners to gain a thorough understanding of grid generation strategies, methodologies and associated algorithms and software tools.

Method of Delivery

Lecture, demonstration and hands-on exercises

Prerequisites

Basic knowledge in numerical methods

Organization Providing the Training

ERC, Mississippi State University

Target Audience

Novice users needing to construct computational grids for numerical simulation

Class Duration

3 days

Students per Class

12

Origin 2000

Description

This course will describe the new architect/features found in the Silicon Graphics Origin 2000. Course discussions will include O-2000 Architecture Overview, Performance Profiling Tools, Parallel Optimization, Memory Management for Parallel Processes, Power Fortran Accelerator (PFA), Synchronization (Locks and Semaphores), Shared Memory and Multiprocesses Debugging.

Method of Delivery

Lecture and demonstration

Prerequisites

Knowledge of UNIX-based systems

Organization Providing the Training

SGI/Cray

Target Audience

High-performance programmers

Class Duration

2 days

Students per Class

12

CRAY T3E Applications Programming

Description

This course is designed for applications programmers who must understand parallel processing concepts and write codes that run on CRAY T3E systems. It provides practical experience in developing, debugging, and analyzing performance of massively parallel programs using the Cray Research parallel programming paradigms and tools. No prior knowledge of parallel programming is assumed in this course.

Method of Delivery

Lecture and demonstration

Prerequisites

Ability to program in Fortran or C, User-level knowledge of UNIX or UNICOS operating systems

Organization Providing the Training

SGI/Cray

Target Audience

Applications programmers for CRAY T3E systems

Class Duration

3 days

Students per Class

12

Parallel Tools and Libraries

Description

This course will give scientific computing programmers an overview of the current High Performance Computing software libraries and tools available. Emphasis will be made on practical issues of implementation and utilization in order to obtain increased computational performance.

Method of Delivery

Lecture and on-line demos

Prerequisites

Some knowledge of C and/or Fortran. Previous experience with scientific computing techniques. Some parallel programming experience preferable.

Organization Providing the Training

CRPC, University of Tennessee at Knoxville

Target Audience

High performance computing scientific programmers

Class Duration

2 days

Students per Class

18

Performance Evaluation of Parallel Systems

Description

This course will give an overview of the principals of parallel performance analysis, parallel benchmarking and scalability analysis.

Method of Delivery

Lecture and on-line demos

Prerequisites

Some knowledge of C and/or Fortran. Previous experience with scientific computing techniques. Some parallel programming experience preferable.

Organization Providing the Training

CRPC, University of Tennessee at Knoxville

Target Audience

High performance computing scientific programmers

Class Duration

2 days

Students per Class

18

Java and the World Wide Web

Description

The objective of this course is to give the students an understanding of the implications of Java for the World Wide Web. An overview of the Java language and its capabilities is presented.

Method of Delivery

Lecture and lab

Prerequisites

Programming experience in a language such as C, C++, or Fortran

Organization Providing the Training

CRPC, Syracuse University

Target Audience

Scientists, computer scientists, and engineers

Class Duration

3 days

Students per Class

12

IBM SP Parallel Programming

Description

This course is designed to train programmers to develop parallel applications on the IBM SP. Students will gain an understanding of issues involved in writing parallel programs and will write, compile, execute, debug and monitor some basic programs. The course will include lectures, demonstrations and hands-on programming labs.

Method of Delivery

Lecture and hands-on laboratory

Prerequisites

Familiarity with Unix and C or Fortran experience

Organization Providing the Training

Ohio Supercomputer Center

Target Audience

Intermediate users

Class Duration

2 days

Students per Class

12

Visualization Systems And Toolkits

Description

VTK is an object-oriented system intended to provide users with a powerful yet relatively simple method for constructing visualization tools. An application written using VTK may be run on a variety of machines from PCs to workstations without modification. In addition, a user wishing to develop rapid prototypes can opt to write a VTK application which is interpreted rather than compiled as a C++ program. This course will discuss the features and capabilities of VTK, and look at many example applications. Several labs will give participants a chance to run and modify demos. This should provide an opportunity for each to assess the potential usability of the system for visualizing data from their own area of research.

Method of Delivery

Lecture and lab

Prerequisites

High performance computing experience

Organization Providing the Training

NCSA, University of Illinois

Target Audience

Scientists, engineers who need to use visualization in their work

Class Duration

2 Days

Students per Class

12

Features of the C++ Programming Language

Description

The purpose of this course is teach the philosophy and syntax of the C++ programming languages. Special emphasis will be placed on two areas:

Improvements to the C programming language found in C++

The object-oriented programming features of C++

Since the object-oriented approach to writing code is a new technique for many users, the course will offer a description of and rationale for this powerful programming style. In terms of the C++ language in particular, the following topics will be covered: the class data type for object creation and use, the various types of C++ functions, function and operator overloading, inheritance and class hierarchies, the C++ I/O stream, and abstract data types.

Method of Delivery

Lecture, hands-on laboratory

Prerequisites

C programming knowledge/experience

Organization Providing the Training

Ohio Supercomputer Center

Target Audience

Novice to intermediate users

Class Duration

3 days

Students per Class

12

SGI ProDev Workshop/Speedshop

Description

Speedshop/Workshop are system tools that assist the programmer in allocating memory, checking the system resources in use and are designed to assist the programmer in proficient use of the platform in use.

Method of Delivery

Lecture and hands-on laboratory

Prerequisites

Experience programming and using system tools

Organization Providing the Training

Ohio Supercomputer Center

Target Audience

Scientists and engineers who need to use Workshop/Speedshop in their work

Class Duration

2 days

Students per Class

12

Parallel Programming Workshop for Fortran Programmers

Description

The workshop will begin with a one-day lecture on strategy, tools, and examples in parallel programming. On the remaining days participants will work with their own codes.

Method of Delivery

Hands-on laboratory

Prerequisites

Basic knowledge of parallel processing and familiarity with the Fortran programming language. Participants must bring a candidate code to be parallelized. Familiarity with that code is helpful.

Organization Providing the Training

CEWES MSRC

Target Audience

Application programmers who have codes they are interested in porting to parallel processors.

Class Duration

3 to 5 days

Students per Class

6

CTH: A Software Family for Multidimensional Continuum Mechanics Analysis

Description

CTH is a family of codes under development at Sandia National Laboratories for use in modeling complex multidimensional (one-, two-, and three-dimensional), multi-material problems that are characterized by large deformations and/or strong shocks. This course will present an extended overview of the features, capabilities, and usage of the CTH family of codes. Sample problems will be constructed, executed, and analyzed during interactive terminal sessions. Information will also be provided regarding ongoing CTH development activities. At the conclusion of the course individuals should be prepared to use CTH as a tool in the analysis of realistic problems.

Method of Delivery

Lecture and hands-on laboratory

Prerequisites

Some training or experience in the numerical solution of problems in structural mechanics.

Organization Providing the Training

Sandia National Laboratories

Target Audience

Individuals interested in using CTH as a tool in the analysis of realistic problems.

Class Duration

3 days

Students per Class

12

B Seminars

Solution of the Time-Dependent Incompressible Navier-Stokes Equations - Numerical, Parallelization and Performance Issues

by

Dr. Danesh Tafti
Senior Research Scientist, Applications
National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign

Friday, April 25, 1997
Classroom 1034
CEWES MSRC

Java and HPC

by

Prof. Geoffrey Fox
Director of NPAC
Syracuse University

1:00 p.m. Wednesday, July 23, 1997
P. K. Senter Conference Room
CEWES MSRC

PVMPI: Interoperating Multiple MPI Vendor Implementations with Unified Process Management

by

Dr. Graham E. Fagg
Innovative Computing Lab
Computer Science Department
University of Tennessee at Knoxville

9:00 a.m. Wednesday, October 29, 1997
P. K. Senter Conference Room
CEWES MSRC

and

10:00 a.m. Thursday, October 30, 1997
Peoples Science Building, Room 209
Jackson State University

C News Releases

Newly Emergent Web Technologies Make Unique Distance Learning Course a Reality

Partnership between academia and the federal government “a precursor to the ‘virtual university’ ”

Every Tuesday and Thursday afternoon, a group of students at Jackson State University (JSU) in Jackson, Miss., meet for a computer science class taught by the faculty of Syracuse University in Syracuse, N.Y., using the Internet. The Department of Defense (DoD) is utilizing this testbed to produce new distance learning solutions for geographically distributed laboratory personnel.

According to Professor Willie Brown, chair of the Jackson State University Department of Computer Science, which resides in the School of Science and Technology, “This project represents a tremendous opportunity for the computer science faculty and students at Jackson State. It is a precursor to the ‘virtual university,’ which will leverage the faculties of many institutions and extend educational opportunities to students throughout DoD and the nation.

“We consider Jackson State extremely fortunate to be on the cutting edge of the collaborative-environment technology that is making this type of distance learning feasible.”

This is the first full-semester academic course to be taught for credit as part of a distance education partnership involving the Computer Science Department of JSU, the Northeast Parallel Architectures Center (NPAC) at Syracuse University, the U.S. Army Corps of Engineers Waterways Experiment Station (CEWES) in Vicksburg, Miss., and Nichols Research Corp. under the sponsorship of the Department of Defense High Performance Computing Modernization (HPCM) Program.

Dr. N. Radhakrishnan, director of the Information Technology Laboratory at CEWES, said, “We consider this activity to be of primary importance in achieving our goal of minimizing the ‘importance of place’ for our Department of Defense research and development community. CEWES is fortunate to have Syracuse and Jackson State conducting this demonstration project. We look forward to rapidly leveraging these capabilities for the benefit of our HPC users.”

The project, using technology developed by NPAC researchers for collaboration and education delivery over the Internet, is piloting cost-effective ways to deliver cutting-edge courses often found at large research universities to the DoD HPC user community.

A secondary benefit of this activity is realized by using JSU as the demonstration partner, thereby extending HPC educational opportunities to a historically black university and utilizing its unique position as the largest producer of African American computer science graduates in the nation. This will allow more minority students to receive education in high technology areas using the Internet.

In the near future, the same technology will be used to provide geographically dispersed researchers working for the Department of Defense—or other large government or commercial organizations with similar access to advanced educational opportunities—without the expense and disruption of travel and extended time away from work.

Distance education is not a new idea, but the Syracuse-Jackson State effort is novel because it uses newly emergent technologies, including hypertext markup language (HTML—the “language” of the World Wide Web) and Java, to provide a robust teaching environment capable of two-way audio and video, a “whiteboard” that is broadcast to the desktop, and a mechanism for “projecting” viewfoils on each student’s computer screen.

The Syracuse-based instructors—Professor Geoffrey Fox (director of NPAC), Dr. Nancy McCracken and Tom Scavo—are teaching the Jackson State students about precisely these same tech-

nologies in this fully accredited, semester-length course, drawing on NPAC's extensive research in this area as well as course materials developed for students in Syracuse's L.C. Smith College of Engineering and Computer Science.

At Jackson State, Dr. Debasis Mitra will serve as the course coordinator, with Mr. Mike Robinson as the network training lead.

Initial development of the technologies and the course materials was funded by the U.S. Air Force Rome Laboratory and SU's L. C. Smith College of Engineering and Computer Science.

The current effort was funded under the Programming Environment and Training (PET) portion of the HPCM Program, which supports technology transfer from university HPC centers to the Department of Defense. Nichols Research is the prime integration contractor for the CEWES Major Shared Resource Center in Vicksburg, one of four such HPC centers chartered to provide state-of-the-art high-performance computing tools and facilities to defense researchers.

Mississippi State University serves as the lead academic institution for the PET component of the CEWES center. Additional academic partners include Syracuse University, Jackson State University, Rice University, the University of Illinois, Clark Atlanta University, the University of Tennessee-Knoxville, Ohio State University and the University of Texas-Austin.

For additional information, contact Dr. David Bernholdt at Syracuse University (315) 443-3857 or Professor Willie Brown at Jackson State University (601) 968-2105.